

HABITAT ASSOCIATIONS OF THE BARRED OWL IN THE BOREAL FOREST OF SASKATCHEWAN, CANADA

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ABSTRACT.—Little information exists regarding Barred Owl (*Strix varia*) habitat requirements in the boreal forest. During 1993, we located Barred Owls through call-playback surveys in the boreal forest of central Saskatchewan, Canada. We analyzed habitat found within 1.5 km and 3.0 km radius circles centered on 25 Barred Owl locations, 100 random locations and 275 survey locations. We compared habitat found within random circles to that found at survey and owl locations. Habitat at survey locations differed from random locations for four habitat types, indicating a habitat bias of road-based surveys. Barred Owls were found associated with old mixed-wood forest, old deciduous forest and water, and avoided young forest and treed muskeg. As in other portions of its range, the Barred Owl is associated with old forest in boreal forest.

KEY WORDS: *Strix varia*; *Barred Owl*; *boreal forest*; *habitat association*; *Saskatchewan*.

Asociaciones de hábitat en búhos (*Strix varia*) en bosques boreal en Saskatchewan, Canada

RESUMEN.—Poca información existe con respecto de requisitos de hábitat para búhos (*Strix varia*) en bosques boreal. Durante 1993 nosotros localizamos búho con llamadas recordadas en el bosque boreal de el centro Saskatchewan, Canada. Nosotros analizamos hábitat dentro 1.5 km y 3.0 km radio círculos centrados en 25 lugares de 25 búhos, 100 lugares al azar y 275 lugares de encuesta. Nosotros comparamos el hábitat dentro los círculos al azar con los de encuesta y lugares de búho. Hábitat en lugares de encuesta eran diferentes a lugares al azar para cuatro tipos de hábitat, indicando una tendencia de hábitat de encuesta con caminos. Búhos fueron encontrados dentro de bosque variables, bosque de hoja caduca y agua y evitaba bosque jóvenes. Como en otras lugares de la pradera, el búho esta asociado con bosques viejos en bosques boreal.

[Traducción de Raúl De La Garza, Jr.]

Habitat associations of Barred Owls (*Strix varia*) have been quantified for only a portion of their range, primarily the northeastern U.S. (Nicholls

and Warner 1972, Devereux and Mosher 1984, Elogy and Sloan 1985, Bosakowski et al. 1987, Laidig and Dobkin 1995). In this region, Barred Owls typically occupy large contiguous tracts of mature to old-growth hardwood and mixed hardwood/softwood forests. Some authors have also suggested a need for swamps and an association with water

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(Bent 1961, Bosakowski et al. 1987, Dunbar et al. 1991, Laidig and Dobkin 1995). Its relatively narrow habitat requirements have resulted in its adoption as a forest-management indicator in the southern Appalachians (Bosakowski 1994). During this century, the Barred Owl is believed to have expanded its range into boreal forests to the western montane forests of Canada and the U.S. (Houston 1959, Taylor and Forsman 1976, Boxall and Stepney 1982, Sharp 1989, Dunbar et al. 1991). In the western portion of their range, Barred Owls were found in association with old-growth and mature coniferous and mixedwood forests and riparian zones (Hamer 1988, Dunbar et al. 1991). Van Ael (1996) reported Barred Owls in northwestern Ontario to be found in association with unfragmented mixed-wood forests. Records from the western boreal forest suggest a relationship with old forests, but this relationship has yet to be quantified (Boxall and Stepney 1982, Pinel et al. 1991). Our objective was to identify which habitat in the boreal forest of Saskatchewan Barred Owls were associated with, and to compare this to the available habitat.

STUDY AREA

This study was conducted in the southern boreal forest of Saskatchewan, Canada (53°35'–54°15'N, 105°05'–106°45'W). The 400 000-ha study area encompassed the Prince Albert Model Forest including a portion of Prince Albert National Park. The dominant tree species in the study area included trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), white birch (*Betula papyrifera*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), tamarack (*Larix laricina*), jack pine (*Pinus banksiana*) and balsam fir (*Abies balsamea*). Habitats included pure deciduous, mixed coniferous/deciduous and pure coniferous forest, muskeg and shrub lands. Elevation ranged from 490–698 m. The topography is gently rolling, interspersed with numerous lakes and creeks. The climate is boreal continental, with an average annual precipitation of 40.1 cm; 28.1 cm as rain and 12.0 cm as snow. July and January temperatures average 17.6°C and –19.7°C, respectively, with annual extreme temperatures of 36.1°C and –48.3°C (Environment Canada Parks 1986). A portion of the study area is currently being commercially harvested for wood pulp and lumber. Approximately half of the study area is located within the boundaries of Prince Albert National Park.

METHODS

Barred Owl locations were estimated through nocturnal call-surveys from 28 April–28 May 1993. Call-surveys were restricted to randomly-selected, vehicle-accessible roads, and were conducted between one half hour after sunset and one half hour prior to sunrise. Call-survey stops were spaced 1 km apart. Thirteen survey routes, totalling 275 call-survey stops, were each surveyed once.

These call-survey stops represented the survey locations. Territorial calls of a male and a female Barred Owl were broadcast using a 12-watt battery powered tape recorder with 4 directional speakers (MTC Electronics), set approximately 1.5 m above the ground. Surveyors remained at each survey stop for 8 min consisting of an initial 1 min listening period prior to broadcast, followed by a 2 min broadcast, and concluding with a 5 min post-broadcast listening period. McGarigal and Fraser (1985) and Mosher et al. (1990) found that 70–80% of Barred Owls detected during the post-broadcast listening period responded within 5 min of the end of the broadcast period. Surveys were not conducted during periods of precipitation or when wind speed exceeded 15 km/hr as reported by Environment Canada, or scored 3 or greater on the Beaufort scale.

At each survey stop where owls responded, we recorded the following parameters: the apparent direction to the owl (to the nearest degree), number and sex of owls responding, time for owl to respond and if the owl(s) was observed. Owl locations were determined by triangulation from at least two consecutive survey stops, or by direct observation of the owl, in which case the survey location was used as the *owl location*. One hundred random locations were generated throughout the study area, in order to compare available habitats. These random locations did not include locations on water surfaces.

We characterized habitat within 1.5 and 3.0 km radius circles (706 and 2827 ha, respectively) centered on 25 owl locations, 100 random locations and 275 survey locations. Of the 25 owl locations where habitat was characterized, seven represented a pair of owls and 18 represented a single owl. Area of overlap of adjacent circles were intersected with Thiessen polygons and the overlap divided between the two circles to prevent double counting of any habitat area. Therefore, overlapping circles had a reduced area as the overlapping area was divided between the two circles.

Although previous studies used smaller circles as an estimate of the area used by Barred Owls (Laidig and Dobkin 1995), radiotelemetry data from 14 adult Barred Owls revealed that annual home ranges (95% MCP) of Barred Owls in our study area ranged from 692–2489 ha (\bar{x} = 1361 ha) (Mazur 1997). We therefore chose circles of 1.5 and 3.0 km radius which more closely approximated the area used by Barred Owls in this region. The circles do not represent an owl's home range, but rather provide an area with which an owl is likely to be associated.

We used the 1993 forest inventories for Prince Albert National Park (Padbury et al. 1978) and Saskatchewan Northern Provincial Forest (Lindenau 1985) to classify the available habitat into 12 types (Table 1). The proportional coverage of each habitat within each circle was calculated using an ARC/INFO geographic information system (GIS). As the data did not conform to a normal distribution we used nonparametric statistics (Zar 1996). We tested for differences between habitat associated with owl and random, and survey and random locations for both 1.5 and 3.0 circles using the Mann-Whitney *U*-test (Zar 1996).

Table 1. Habitat classification of the Prince Albert National Park study area by habitat cover type and age.

HABITAT TYPE	COVER VEGETATION DESCRIPTION
Deciduous ¹	Trembling aspen +/- or balsam poplar +/- or white birch (<20% conifer)
Mixed-wood ¹	Combination of deciduous and coniferous species: trembling aspen, balsam poplar, white birch, white spruce, black spruce, jack pine, balsam fir ($\geq 20\%$ conifer, $\geq 20\%$ deciduous)
Coniferous ¹	White spruce +/- or black spruce +/- or jack pine +/- or tamarack +/- or balsam fir (<20% deciduous)
Treed Muskeg	Black spruce +/- or tamarack, excessive moisture and retarded tree growth
Open	Cut over, burn over, flooded land, sand, clearing, open muskeg, herbs, shrubs
Water	Lakes, rivers, creeks

¹ Could occur in three age classes: young (<50 years), mature (50–79 years) and old (80+ years).

RESULTS

Survey Locations versus Random Locations.

Habitat composition surrounding survey locations (e.g., habitat adjacent to roads) was found to differ from habitat composition found at random locations (e.g., habitat throughout the study area) (Figs. 1a and 1b). Significant differences were found between the proportions of two habitat types within the 1.5 circles and four habitat types within the 3.0 circles. Survey 1.5 circles were found to have significantly less mature conifer ($z = -5.23$, $P = 0.000$) and treed muskeg ($z = -5.06$, $P = 0.000$) than did random 1.5 circles (Fig. 1a). Within survey 3.0 circles, there were significantly more mature deciduous ($z = -2.09$, $P = 0.025$), and significantly less mature mixed-wood ($z = -3.07$, $P = 0.001$), mature conifer ($z = -4.79$, $P < 0.001$), and treed muskeg ($z = -4.10$, $P < 0.001$) compared to random 3.0 circles (Fig. 1b).

Owl Locations versus Random Locations. Barred Owls were associated with habitat types in different proportions than expected from the available habitat. Habitat composition of owl 1.5 and 3.0 circles differed from random 1.5 and 3.0 circles for four habitat types within the 1.5 km circles and six habitat types within the 3.0 km circles (Figs. 2a and 2b). Within the 1.5 circles, owl locations were found to have significantly higher proportions of old mixed-wood ($z = -3.53$, $P < 0.001$) than random circles, and significantly lower proportions of young mixed-wood ($z = -1.87$, $P = 0.038$), young conifer ($z = -2.27$, $P = 0.011$) and treed muskeg ($z = -3.24$, $P = 0.001$) than random circles (Fig. 2a). Within the 3.0 circles, owl locations were found to have significantly higher proportions of old deciduous ($z = -2.39$, $P = 0.014$), old mixed-

wood ($z = -2.29$, $P = 0.021$) and water ($z = -3.82$, $P < 0.001$) and significantly lower proportions of young mixed-wood ($z = -2.36$, $P = 0.012$), young conifer ($z = -2.44$, $P = 0.010$) and treed muskeg ($z = -3.30$, $P < 0.001$) than random circles (Fig. 2b).

DISCUSSION

Our results indicated that Barred Owls were not randomly distributed relative to the available habitat. Owls showed a greater than expected association with old deciduous forest, old mixed-wood forest and water, and an avoidance of young forest and treed muskeg. This agrees with what has been recorded previously in the boreal forest (Boxall and Stepney 1982, Van Ael 1996). Barred Owls are cavity-nesting owls, requiring relatively large trees (Johnsgard 1988). In Maryland, Devereux and Mosher (1984) reported an average diameter at breast height (dbh) of 61 cm for Barred Owl nest trees. Similarly, in our study area Barred Owl nest trees average 47 cm dbh. Old mixed-wood forest is likely the only forest type in the boreal setting that provides an adequate density of large diameter (>40 cm dbh) trees (Lee et al. 1995). The old mixed-wood forest is the most structurally and species diverse habitat type in the boreal forest (Stelfox 1995). Therefore, prey diversity and abundance is likely high in this habitat. The positive association with water has also been documented in the past (Sutton and Sutton 1985, Bosakowski et al. 1987, Pinel et al. 1991). In some areas suitable habitat for Barred Owls is largely restricted to wet areas (Devereux and Mosher 1984). In our study area, the forest was largely continuous, with available habitat in both upland and lowland areas. We

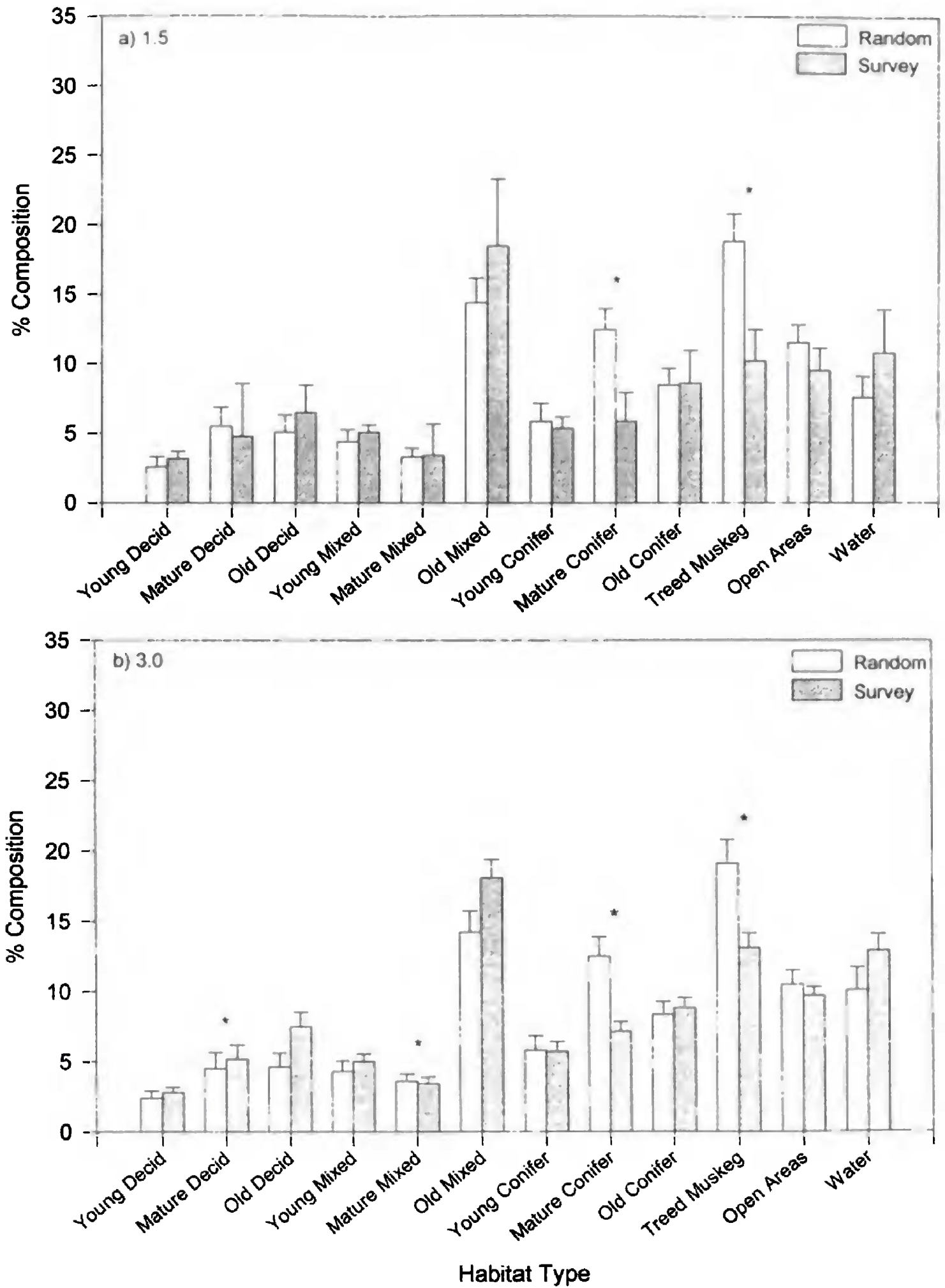


Figure 1. Comparison of mean percent habitat composition (\pm SE) within (a) 1.5 km radius circles (706 ha) and (b) 3.0 km radius circles (2827 ha), centered on 100 random and 275 survey locations. Significant difference * ($P < 0.05$).

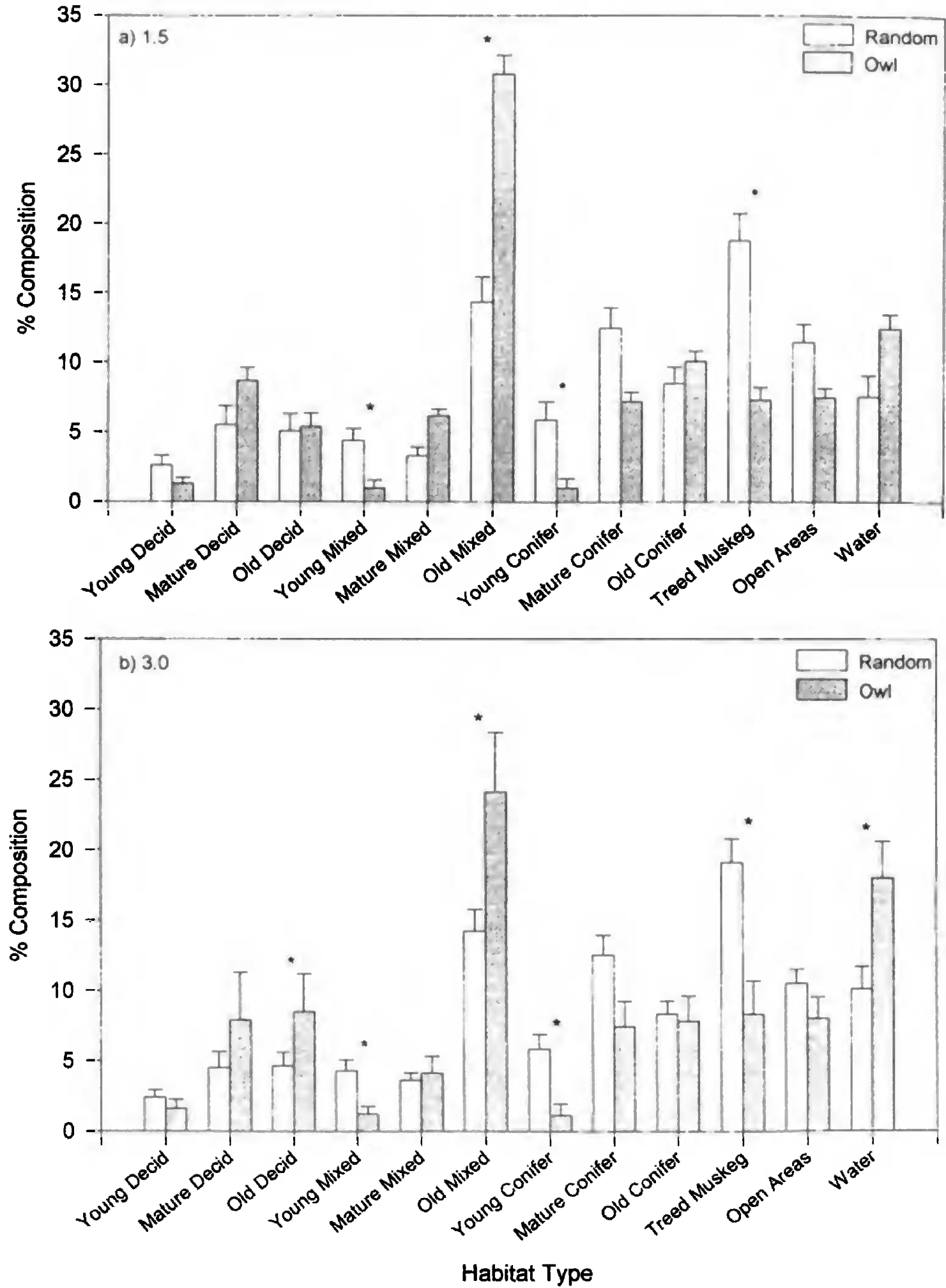


Figure 2. Comparison of mean percent habitat composition (\pm SE) within (a) 1.5 km radius circles (706 ha) and (b) 3.0 km radius circles (2827 ha), centered on 100 random and 25 owl locations. Significant difference * ($P < 0.05$).

found Barred Owls in both upland and lowland areas.

Habitat associated with survey locations was found to be representative of the habitat within the study area, with the exception of four habitat types. Typically, roads were built on higher areas, avoiding low-lying muskeg and wetlands. This was evident as the percentage of treed muskeg associated with survey locations was significantly lower than that of random locations. We suggest that when comparing habitat use to availability, habitat adjacent to roads presents an available habitat bias, and therefore comparisons between habitat use and random habitat should be made.

Habitat characterization of circles centered on owl locations contained biases making them not entirely representative of owl home ranges. Owls detected may have moved toward the tape playback, or the owl may have been detected calling from the periphery of its home range. However, Lehmkuhl and Raphael (1993) supported the use of circles as surrogates for home ranges in the analysis of habitat pattern associations of Spotted Owls (*Strix occidentalis*) in Washington. Few differences in habitat composition were apparent between 1.5 km circle comparisons and 3.0 km circle comparisons. However, the smaller circles would present a more conservative estimate of the area that the owl likely uses. Given that the 3.0 circle approximates the maximum Barred Owl home range size, this larger circle size may include large areas of unused habitat.

Our findings show that in the boreal forest, like other regions, Barred Owls are associated with old forest, in this case old mixed-wood forest. This species appears to have the potential to serve as a biological indicator for the management of old mixed-wood forest in the boreal forest (James 1993). Knowledge of the Barred Owl's specific habitat and area requirements would allow for management of an adequate quantity of old mixed-wood forest, therefore sustaining this highly species diverse habitat.

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